

## A REVIEW OF *NEBALIELLA* (CRUSTACEA: LEPTOSTRACA) WITH THE DESCRIPTION OF A NEW SPECIES FROM THE CONTINENTAL SLOPE OF SOUTHEASTERN AUSTRALIA

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### Abstract

Walker-Smith, G.K., 1998. A review of *Nebaliella* (Crustacea: Leptostraca) with the description of a new species from the continental slope of southeastern Australia. *Memoirs of the Museum of Victoria* 57: 39–56.

The genus *Nebaliella* Thiele, 1904 is reviewed and a new species is described from Point Hicks, Victoria, Australia. This is the first record of the genus from Australia and the fifth species of *Nebaliella*. Previously only 47 individuals world-wide had been recorded making the addition of 9 individuals to the literature significant. Sexual dimorphism within the genus is discussed and a key to the species is included.

### Introduction

*Nebaliella* Thiele, 1904 belongs to the leptostracan family *Nebaliidae* Baird, 1850 with five other genera; *Nebalia* Leach, 1814, *Paranebalia* Claus, 1880, *Dahlella* Hessler, 1984, *Sarsinebalia* Dahl, 1985 and *Speonebalia* Bowman, Yager and Iliffe, 1985. The main features distinguishing *Nebaliella* from other nebaliiids are: the presence of large curved eyestalks lacking visual elements and denticles, a rostral keel extending beyond the rostral flange, thoracopods without epipods and pleopod 6 larger than pleopod 5.

*Nebaliella* was erected for its type species *Nebaliella antarctica* from Kerguelen, Southern Ocean (Thiele, 1904). Thiele (1904) suggested a specimen collected from Akaroa Harbour, New Zealand also belonged to this species. A year later Thiele (1905) described a second species, *N. extrema* from 15 specimens collected off the coast of Kaiser Wilhelm II Land, Eastern Antarctica. *Nebaliella extrema* has also been recorded from Western Antarctica in the Palmer Archipelago (Cannon, 1931). In a series of expeditions in 1972, 1974–75 and 1982 to the subantarctic region of Kerguelen and Crozet Island, Ledoyer (1993) recorded ten specimens of *N. antarctica* from Kerguelen. These specimens included males and juveniles but females were not mentioned. During the same expeditions Ledoyer (1993) also recorded *N. extrema* from

the Weddell Sea (5 specimens) and Kerguelen (1 specimen). *Nebaliella antarctica* has been recorded in shallow water ranging in depth from 9 m to 190 m while depth records for *N. extrema* range from 160 to 385 m.

In 1932 Clark described *Nebaliella caboti* from a single male found in the Cabot Strait between Newfoundland and Cape Breton Island, Canada, at a depth of 378 m. *Nebaliella caboti* has also been recorded in New Jersey, USA on the lower portion of the continental slope at 2085 m (Hessler and Sanders, 1965) and the Rockall Trough at depths of 1390–2900 m (Mauchline and Gage, 1983). *Nebaliella brevicarinata*, the fourth species reported, was described from a single female from 270 m off the Princess Ragnhild Coast, Antarctica (Kikuchi and Gamô, 1992).

The fifth species, described here, was collected off the southeastern coast of Victoria, the eastern coast of New South Wales and Tasmania, Australia. The species was the only one in its genus collected during extensive sampling on the continental slope in this region (Poore et al., 1994). Several other undescribed species of *Nebaliidae* were collected at the same time. *N. declivatus* sp. nov. is a deep water species, found on the continental slope in water at 996–1840 m.

The addition of an Australian species to the literature extends the known geographical distribution of the genus (Table 1).

Table 1. Distribution of species of *Nebaliella*

| Species  | Locality                            | No. of individuals | Depth recorded (m) | References                |
|--|-------------------------------------|--------------------|--------------------|---------------------------|
| <i>N. antarctica</i> Thiele, 1904              | Kerguelen, Southern Ocean           | 3                  | 9-20               | Thiele, 1904              |
|  | Akaroa Harbour, New Zealand         | 1                  | ?                  | Thiele, 1904              |
|  | Kerguelen, Southern Ocean           | 3                  | 50-150             | Hale, 1937                |
| <i>N. extrema</i> Thiele, 1905                 | Kerguelen, Southern Ocean           | 10                 | 15-190             | Ledoyer, 1993             |
|  | Kaiser Wilhelm II Land, Antarctica  | 15                 | 380-385            | Thiele, 1905              |
| <i>N. caboti</i> Clark, 1932                   | Palmer Archipelago, Antarctica      | 1                  | 160-335            | Cannon, 1931              |
|  | Weddell Sea, Antarctica             | 5                  | 270-399            | Ledoyer, 1993             |
|  | Kerguelen, Southern Ocean           | 1                  | 177                | Ledoyer, 1993             |
|  | Cabot Strait, Canada                | 1                  | 378                | Clark, 1932               |
|  | Off New Jersey, USA                 | 1                  | 2085               | Hessler and Sanders, 1965 |
| <i>N. brevicarinata</i> Kikuchi and Gamó, 1992 | Rockall Trough, Ireland             | 5                  | 1392               | Mauchline and Gage, 1983  |
|  | Princess Ragnhild Coast, Antarctica | 1                  | 270                | Kikuchi and Gamó, 1992    |
| <i>N. declivatas</i> sp. nov.                  | Point Hicks, Vic., Australia        | 6                  | 1840               | present study             |
|  | Nowra, NSW, Australia               | 1                  | 996                | present study             |
|  | Cape Tourville, Tas., Australia     | 2                  | 1264               | present study             |

All specimens examined came from the collections of the Museum of Victoria (NMV). Specimens were dissected and mounted in glycerol and slides were viewed under an Olympus BH-2 or an Olympus BX50 compound microscope. Whole specimens and body parts were drawn with the aid of a camera lucida. Plumose setae are numerous on many body parts but in most cases they have been figured without their setules so as not to obscure other details. Abbreviations used in figures are as follows: RO, rostrum; E, eyestalks; A1, antenna 1; A2, antenna 2; MD, mandible; MX1, maxilla 1; MX2, maxilla 2; T1–T8, thoracopods 1–8; P1–P6, pleopods 1–6; CR, caudal rami or furca; A, anal scales.

### *Nebaliella* Thiele

*Nebaliella* Thiele, 1904: 4–9, 24–25.—Cannon, 1931: 216–221.

*Type species. Nebaliella antarctica* Thiele, 1904 by monotypy and original designation.

*Diagnosis.* Eyestalks strongly curved, extending beyond the ventral margin of the rostral keel and lacking visual elements. Rostral keel longer than rostral flange. Mandibular incisor with 3 teeth, palp article 3 with a continuous row of setae along lateral and distal margins. Thoracopods without epipods. Smooth setae on lateral margin of pleopod 2 exopod not in pairs. Pleopod 6 longer than pleopod 5.

*Composition.* *N. antarctica* Thiele, 1904; *N. brevicarinata* Kikuchi and Gamô, 1992; *N. caboti* Clark, 1932; *N. declivatas* sp. nov.; *N. extrema* Thiele, 1905. See Table 1 for distribution.

*Remarks.* The eyestalks of *Nebaliella*, as in some species of *Sarsinebalia* and *Nebalia*, lack visual elements; they are strongly curved, and extend beyond the ventral margin of the rostrum like the eyestalks of *Dahlella caldariensis* but, unlike *D. caldariensis* the eyestalks lack denticles. Antenna 2, articles 3 and 4 are not fused in *Nebaliella*, *Speonebalia* and *Nebaliopsis* Sars, 1887 (Nebaliopsidae) but are fused or partially fused in other genera of Leptostraca. Thoracopodal epipods are absent in *Nebaliella* but present in other leptostracan genera. Pleopod 6 is larger than pleopod 5 in *Nebaliella* (Nebaliidae) and *Nebaliopsis* (Nebaliopsidae) but the reverse is true in other Nebaliidae.

*Sexual dimorphism.* The most obvious sexually dimorphic feature of males is the presence of a heavily setose peduncle and flagellum on antenna 2 which extends to the caudal furca (Figs 6 and 7). This flagellum is twice as long as in females. The flagellum of antenna 1 is also much longer in the males, extending beyond the caudal furca. A rudimentary flagellum, in addition to the normal flagellum, has also been observed on antenna 1 of females of *N. antarctica* and *N. declivatas*. This appears as a setose single article and is not found in males.

### Key to species of *Nebaliella*

1. Ratio of rostral flange to exposed keel approximately 1:1 (Fig. 1E, F).....2
- Ratio of rostral flange to exposed keel approximately 3:1 (Fig. 1A, B).....  
.....*N. antarctica* Thiele, 1904.
2. Carapace posterior margin not extending beyond pleonite 4 or less; body length more than twice carapace length; antenna 2 (Fig. 1G), article 1 with short spine on dorsodistal edge, article 2 with slender seta on distoventral corner of article 2; mandibular palp with strong spine on article 2 (Fig. 1H).....*N. brevicarinata* Kikuchi and Gamô, 1992
- Carapace posterior margin extending beyond pleonite 4; body length less than twice carapace length; antenna 2 without slender seta on distoventral corner of article 2; mandibular palp without strong spine on article 2.....3
3. Carapace posterior margin extending to pleonite 5; maxilla 2 endopod (female) 1-articulate; pleopod 1 (male, female P1 unknown) exopod with a row of 13 setae increasing in length distally and becoming spiniform, along lateral margin.....*N. caboti* Clark, 1932
- Carapace posterior margin extending to pleonite 5; maxilla 2 endopod (female) 2-articulate in female (Fig. 1L); pleopod 1 (female) exopod with 17–19 short setae and 8–10 longer setae along lateral margin (Fig. 1M).....  
.....*N. extrema* Thiele, 1908
- Carapace posterior margin extending beyond pleonite 7; maxilla 2 endopod 1-articulate in female; pleopod 1 (female) exopod with 6 short plumose setae and 11 longer plumose setae along lateral margin (Fig. 4).....  
.....*N. declivatas* sp. nov.

*Nebaliella antarctica* Thiele

*Nebaliella antarctica* Thiele, 1904: 4-9, 24-25.—Hale, 1937: 55-56.—Ledoyer, 1993: 77-78.

**Diagnosis.** Body more than twice length of carapace. Carapace posterior margin covering pleonite 4 or less; without carina on anterolateral lower corner. Ratio of rostral flange to exposed keel approximately 3:1 (Fig. 1A, B). Antenna 2 with dorsal spine on article 1 and ventral horn-like projection or heel on article 2 (Fig. 1C); without slender seta on distoventral corner of article 2. Mandibular palp, article 2 with 4 setae; without strong spine on article 2. Maxilla 2 endopod (female) 1-articulate. T8 endopod 4-articulate (Fig. 1D). P1 exopod (female) with 19-23 short setae and 9 longer setae (including terminal ones). Pleopod 6 half length of pleonite 6.

**Distribution.** Kerguelen, Southern Ocean; Akaroa Harbour, New Zealand. 9-190 m depth.

**Remarks.** The most distinguishing feature of *Nebaliella antarctica* is its large rostral flange. The ratio of the flange to exposed keel is approximately 3:1 for *N. antarctica* but only 1:1 for all other species of *Nebaliella*. *Nebaliella antarctica* is also the only species of *Nebaliella* to possess 4 setae on article 2 of the mandibular palp. The number of articles in the protopod of maxilla 1 is uncertain. Thiele (1904) illustrated it as 1-articulate but Ledoyer (1993) drew a 3-articulate structure. As in *N. brevicarinata* the carapace of *N. antarctica* extends only as far as pleonite 4, but unlike *N. brevicarinata* the carapace does not possess a carina on the anterolateral lower corner.

*Nebaliella brevicarinata* Kikuchi and Gamô

*Nebaliella brevicarinata* Kikuchi and Gamô, 1992: 83-89.

**Diagnosis.** Body more than twice length of carapace. Carapace posterior margin covering pleonite 4 or less; with carina on anterolateral lower corner (Fig. 1J). Ratio of rostral flange to exposed keel approximately 1:1 (Fig. 1E, F). Rostrum with proximoventral tuberculate process (Fig. 1E). Antenna 2 without dorsal spine on article 1; with slender seta on distoventral corner of article 2 (Fig. 1G). Mandibular palp, article 2 with 1 seta; with strong spine on article 2 (Fig. 1H). Maxilla 1, protopod of palp 4-articulate (Fig. 1I). Maxilla 2 endopod (female) 2-articulate. Thoracopod 8 endopod 1-articulate (Fig. 1K). Pleopod 1 exopod (female) 8 short and 9

longer setae along lateral margin. Pleopod 6 approximately 0.75 length of pleonite 6.

**Distribution.** Princess Ragnhild Coast, Antarctica; 270 m depth.

**Remarks.** *Nebaliella brevicarinata* was described by Kikuchi and Gamô (1992) on the basis of a single female. The main character the authors used to distinguish *N. brevicarinata* from other species is a short vertical carina on the lower corner of the anterolateral portion of the carapace (Kikuchi and Gamô, 1992). Ledoyer (1993) observed a similar carina on the carapace of a specimen of *N. extrema*, but believed they were still two distinct species as the armature of pleopod 1 and the peduncle of the antenna were different. On the lateral margin of the pleopod 1 exopod *N. brevicarinata* has 8 short setae and 9 longer setae but *N. extrema* has 17-19 short setae and 8-10 longer setae. Antenna 2 peduncle article 1 has a short stout spine on the dorsodistal edge (Fig. 1G). A spine similar to this was recorded by Hale (1937) for *N. antarctica* (Fig. 1C). Antenna 2 peduncle article 2 of *N. brevicarinata* differs from all other species of *Nebaliella* having a long slender seta at the laterodistal corner. The possession of a strong spine on article 2 of the mandibular palp is a character unique to *N. brevicarinata*.

*Nebaliella caboti* Clark

*Nebaliella caboti* Clark, 1932: 218-225.—Hessler and Sanders, 1965: 72-73.—Mauchline and Gage, 1983: 628-630.

**Diagnosis.** Body 1.75 × length of carapace. Carapace posterior margin partially covering pleonite 5; without carina on anterolateral lower corner. Ratio of rostral flange to exposed keel approximately 1:1. Antenna 2 without dorsal spine on article 1; without slender seta or horn-like projection on distoventral corner of article 2. Mandibular palp, article 2 with 2 setae; without strong spine on article 2. Maxilla 2 endopod (female) 1-articulate. Thoracopod 8 endopod 4-articulate. Pleopod 1 exopod (male, pleopod 1 female unknown) with a row of 13 setae increasing in length distally, becoming spiniform. Pleopod 6 equal to or slightly longer than pleonite 6.

**Distribution.** Cabot Strait, eastern coast of Canada; off New Jersey, USA; Rockall Trough, Ireland; 378-2085 m depth.

**Remarks.** Clark (1932) described *Nebaliella caboti* from a single male and Mauchline and Gage (1983) provided some drawings of a female from Rockall Trough, Ireland. *Nebaliella caboti*



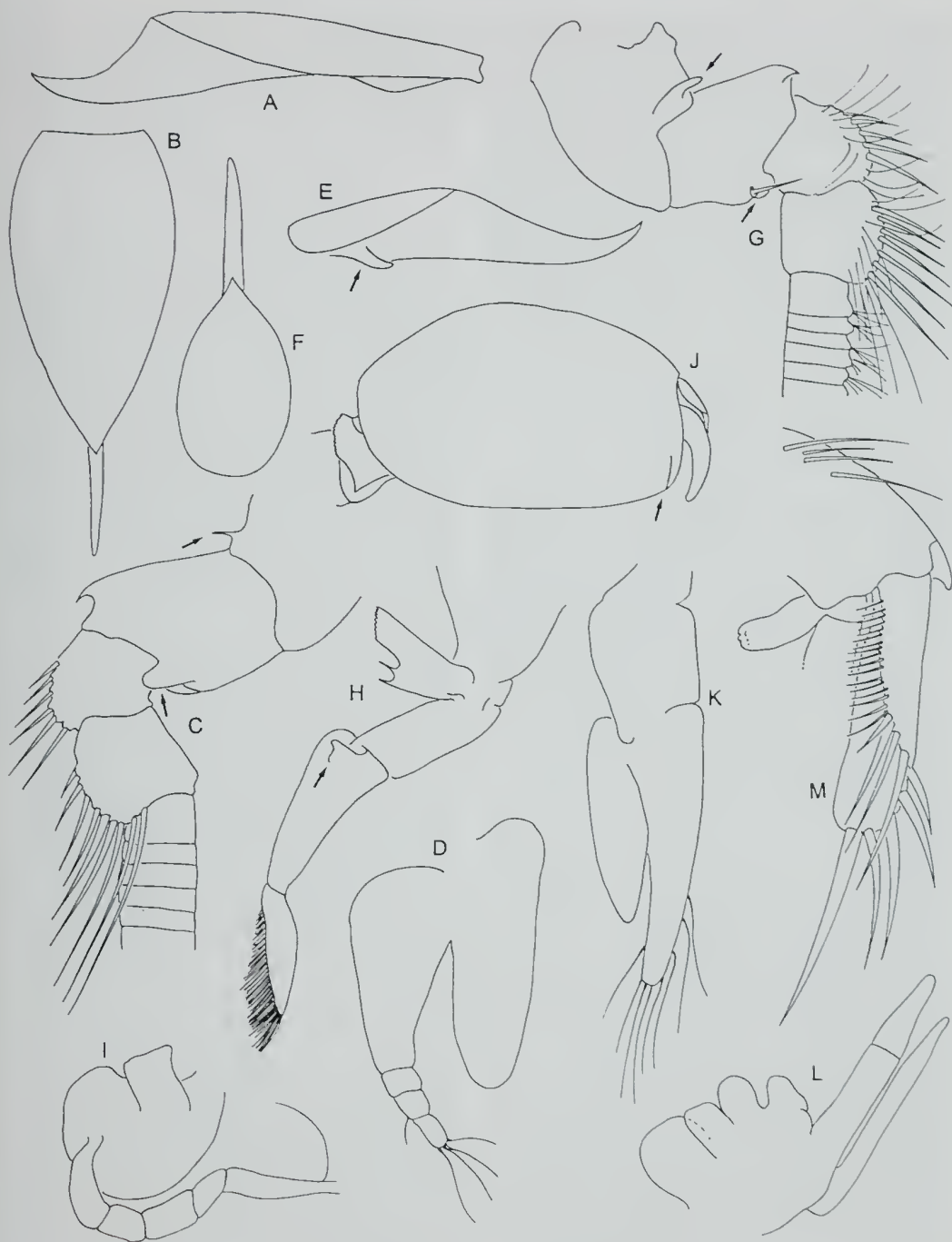


Figure 1. *Nebaliella antarctica* Thiele. A, B, rostrum, ventral and dorsal view; C, antenna 2; D, thoracopod 8. *Nebaliella brevicarinata* Kikuchi and Gamô. E, F, rostrum, ventral and dorsal view; G, antenna 2; H, mandible and mandibular palp; I, maxilla 1; J, carapace; K, thoracopod 8. *Nebaliella extrema* Thiele. L, maxilla 2; M, pleopod 1.

Figures traced from the following references: A–C, Hale, 1937; D, Ledoyer, 1993; E–K, Kikuchi and Gamô, 1992; L, M Ledoyer, 1993.

is most similar to *N. antarctica* and *N. declivatus*, having a carapace without a carina, maxilla 2 endopod 1-articulate and thoracopod 8 endopod with more than 1 article. *Nebaliella caboti* differs from *N. antarctica* in the size of the rostral flange and carapace and the possession of 2 setae on article 2 of the mandibular palp, *N. antarctica* has 4. *Nebaliella caboti* has a much larger pleopod 6 than either *N. antarctica* or *N. declivatus*, being equal to, or slightly longer than pleonite 6. *Nebaliella caboti* also differs from *N. declivatus* having a relatively smaller carapace, extending to pleonite 5 and not 7 as in *N. declivatus*.

#### *Nebaliella extrema* Thiele

*Nebaliella extrema* Thiele, 1905: 61–66.—Cannon, 1931: 216–221.—Ledoyer, 1993: 78–79.

**Diagnosis.** Body less than twice length of carapace. Carapace posterior margin partially covering pleonite 5; sometimes with carina on anterolateral lower corner. Ratio of rostral flange to exposed keel approximately 1:1. Rostrum with proximoventral tuberculate process. Antenna 2 without dorsal spine article 1; without slender seta or horn-like projection on distoventral corner of article 2. Mandibular palp without strong spine on article 2. Maxilla 2 endopod (female) 2-articulate (Fig. 1L). Pleopod 1 exopod (female) with 17–19 short setae and 8–10 longer setae along lateral margin (Fig. 1M). Pleopod 6 as long as pleonite 6.

**Distribution.** Kaiser Wilhelm II Land, Palmer Archipelago, and Weddell Sea, Antarctica; Kerguelen, Southern Ocean. 160–385 m depth.

**Remarks.** *Nebaliella extrema* is distinguished from *N. antarctica* primarily on the basis of the rostrum. The ratio of the rostral flange to exposed keel is approximately 1:1 for *N. extrema* (and all other species of *Nebaliella*) and 3:1 for *N. antarctica*. The posterior margin of the carapace extends to partially cover pleonite 5 as in *Nebaliella caboti* but differs from *N. caboti* with maxilla 2 having a 2-articulate endopod. Maxilla 2 of *N. caboti* has a 1-articulate endopod. The pleopod 1 exopod (female) of *N. extrema* has 17–19 short plumose setae compared to only 6 in *Nebaliella declivatus*. Thiele (1905) did not mention a carina on the carapace of *N. extrema* and it was not illustrated by Cannon (1931). However, Ledoyer (1993) noted the presence of a small carina on the anterolateral lower corner of the carapace of *N. extrema*, similar to that possessed by *N. brevicarinata*. The most significant difference between

*N. extrema* and *N. brevicarinata* is the lack of a slender seta on the distoventral corner of antenna 2 article 2 and the absence of a strong spine on article 2 of the mandibular palp, both features possessed by *N. brevicarinata*.

#### *Nebaliella declivatus* sp. nov.

##### Figures 2–10

**Material examined.** Holotype. Victoria. 76 km S of Point Hicks (38°29.33'S, 149°19.98'E), 1840 m, sandy mud, fine shell, WHOI epibenthic sled, G.C.B. Poore et al. on ORV *Franklin*, 26 Oct 1988 (stn SLOPE 69), NMV J34659 (female).

Paratypes. Victoria. Collected with holotype, NMV J34664. (male, allotype), NMV J34592 (3), NMV J34593 (1).

New South Wales. 54 km ESE of Nowra (34°52.72'S, 151°5.04'E), 996 m, mud, fine sand, fine shell, WHOI epibenthic sled, G.C.B. Poore et al. on ORV *Franklin*, 22 Oct 1988 (stn SLOPE 53), NMV J34594 (1).

Tasmania. 48 km ENE of Cape Tourville (42°00.25'S, 148°43.55'E), 1264 m, gravel with lumps of sandy mud aggregate, WHOI epibenthic sled, G.C.B. Poore et al. on ORV *Franklin*, 30 Oct 1988 (stn SLOPE 81), NMV J34595 (2).

**Diagnosis.** Body approximately 1.5 × length of carapace. Carapace posterior margin extending beyond pleonite 7; without carina on anterolateral lower corner. Ratio of rostral flange to exposed keel approximately 1:1. Rostrum without proximoventral tuberculate process. Antenna 2 without dorsal spine on article 1, without horn-like projection or slender seta on distoventral corner of article 2. Mandibular palp, article 2 with 2 setae; without strong spine on article 2. Maxilla 1, protopod of palp 1-articulate. Maxilla 2 endopod (female) 1-articulate. Thoracopod 8 endopod 5-articulate. Pleopod 1 exopod (female) with 7 short plumose setae, 11 longer plumose setae along lateral margin and 4 terminal plumose setae. Pleopod 6 approximately 0.5 × length of pleonite 6.

**Description of female holotype (without embryos).** Body length (measured from anterior margin of carapace to tip of furca, excluding setae) 8.23 mm; carapace: length 5.23 mm; emarginate; dorsum convex; anterolateral margin narrowly rounded, posterolateral margin more broadly rounded; depth 0.6 × greatest length; 6.9 × length of rostrum; posterior margin reaching beyond pleonite 6; surface not sculptured, ventral surface of dorsodistal margin with row of small spines. Pleonites 2–7: margins entirely denticulate, denticles pointed.

Rostrum: flange length 2.0 × width; length of keel 4.6 × greatest depth of keel; keel 1.9 × length of rostral flange.

Eyestalks: without ommatidia; dorsal margin convex; ventral margin extremely concave; tapering distally; length measured in a straight line from top to bottom of eye;  $1.1 \times$  length of rostrum including keel; length  $3.0 \times$  greatest width; without dorsal papilla; without denticles; supraocular scale absent.

Antenna 1: article 1 without dorsal spine, as wide as article 2; article 2, length  $2.4 \times$  width, 6 mesial plumose setae and numerous distal setae; article 3,  $0.6 \times$  length of article 2, with 7 setae; article 4 with a single row of 10 plumose setae anteriorly; swollen scale, length  $3.6 \times$  width, heavily setose, with plumose setae; flagellum with 8 articles, setae clustered on anterodistal margin of each article; rudimentary second flagellum arising mesially from article 4. Antenna 2: article 2, small dorsal spine present; article 3 length  $1.3 \times$  width, with 1 anterior and 2 lateral rows of setae; articles 3 and 4 not fused; article 4 slightly longer than article 3, with 1 anterior and 2 lateral rows of plumose setae; flagellum with 17 articles.

Mandibular palp 3-articulate: article 2 with 2 medial setae; article 3, equal in length to article 2, margins tapering slightly, 1 row of plumose setae along posterior and distal margin, increasing in length distally, short seta terminally; well developed molar process, without setal brush; mandibular incisor with 3 teeth. Maxilla 1: sympod, endite 1 slightly rounded with 1 row of plumose marginal setae and 2 robust spinulose setae; palp long, well developed, with 3 articles, 13 lateral setae and 2 terminal setae; endite 2 broader than endite 1, with 1 row of stout simple setae, 1 row of plumose setae, and single longer supracuticular plumose seta. Maxilla 2: with 5 endites; endite 1 expanded distally, margin with 2 rows of plumose setae; endite 2 rectangular with 2 rows of plumose supracuticular setae; endite 3 with 2 rows of supracuticular plumose setae; endite 4 approximately half width of endite 3, with 4 plumose setae; endite 5 least developed, with 2 plumose setae; endopod tapering distally,  $0.85 \times$  length of exopod, 1-articulate; mesial margin of endopod with plumose setae; lateral margin of exopod with plumose setae.

Thoracopods: endopods 5-articulate, foliaceous, epipods absent. Ratio of endopods T1:T3 and T1:T8 endopod: 1:1.7 and 1:0.9 respectively. Ratio of exopods T1:T3 and T1:T8 exopod: 1:0.7 and 1:0.5 respectively.

Thoracopod 1: endopod with single mesial row of plumose setae, plumose setae also along posterodistal margin; exopod, lateral margin with

plumose seta, length of exopod approximately equal to endopod. Thoracopod 3: endopod with single mesial row of plumose setae, articles 3–5 with posterolateral setae, article 6 heavily setose along margin; exopod distally rounded,  $0.5 \times$  length of endopod, with evenly spaced plumose supracuticular marginal setae. Thoracopod 8: endopod with mesial and anterior plumose setae; exopod tapering slightly,  $0.6 \times$  as long as endopod, with numerous plumose marginal setae.

Pleopods 1–4: lateral margin of peduncle denticulate; exopod 1-articulate; endopod 2-articulate, article 1 with retinaculum, article 2 with fine, long plumose setae on lateral and mesial margins, 1 robust smooth seta and one short, stout spine terminally.

Pleopod 1: peduncle with 2 groups of anterior plumose setae, 4 short plumose setae mesodistally, lateral margin with tiny spines; exopod,  $0.5 \times$  length of peduncle,  $0.6 \times$  length of endopod, comb-row of 7 short plumose setae along lateral margin of exopod,  $0.2 \times$  length of exopod, 11 longer plumose setae also along lateral margin, 4 plumose setae terminally, mesial margin with numerous long, fine plumose setae. Pleopod 2: peduncle with anterior row of 7 plumose setae, 4 small plumose setae mesodistally; exopod  $0.8 \times$  length of peduncle,  $0.7 \times$  length of endopod, lateral margin with 10 smooth setae, 2 terminal setae, mesial margin with long, fine plumose setae. Pleopod 3: peduncle with anterior row of 5 plumose setae; 4 short plumose mesodistal setae; exopod,  $0.7 \times$  length of peduncle,  $0.6 \times$  length of endopod, 9 subcuticular plumose setae, 2 smooth setae terminally, mesial margin with long, fine, plumose setae. Pleopod 4: peduncle with anteroproximal row of 7 plumose setae, 4 short plumose mesodistal setae; exopod,  $0.8 \times$  length of peduncle,  $0.7 \times$  length of endopod, lateral margin with 11 simple setae, 2 terminally, mesial margin with long, fine plumose setae. Pleopod 5: single ramus, length  $2.7 \times$  width; with robust simple seta on terminal margin; fine plumose setae on lateral and mesial margin. Pleopod 6: single ramus, length  $3.5 \times$  width; with 5 robust simple setae on lateral margin and 2 on terminal margin; small plumose setae on lateral and mesial margin.

Anal scales: triangular.

Caudal furca: length  $3.3 \times$  width;  $1.5 \times$  as long as telson,  $0.3 \times$  as long as carapace; with 21 smooth setae on lateral margin and 9 plumose setae on medial margin, 1 terminal seta.



*Description of male allotype.* Body length 5.57 mm; carapace: length 4.70 mm,  $1.9 \times$  width; dorsum convex; anterior margin rounded, posterior margin more broadly rounded; depth  $0.6 \times$  greatest length; length  $4.6 \times$  length of rostrum; posterior margin reaching anterior region of pleonite 7; surface not sculptured; ventral surface of dorsodistal margin with fine spines. Pleonites 2–7: margins entirely denticulate, denticles pointed;

Rostrum: flange length  $2.0 \times$  width; length of keel  $3.5 \times$  greatest depth of keel; keel  $1.4 \times$  length of rostral flange.

Eyestalks: without ommatidia; dorsal margin convex; ventral margin extremely concave; tapering distally;  $1.2 \times$  length of rostrum including keel; without dorsal papilla; without denticles; supraocular scale absent.

Antenna 1: article 1 with dorsal spine; article 2, length  $2.5 \times$  width, 8 mesial plumose setae and numerous distal setae; article 3, with group of distal setae; article 4 with a single row of 7 plumose setae anteriorly; swollen scale narrower than for female, length  $4.4 \times$  width, distally setose, with plumose setae; flagellum longer than carapace, extending beyond end of caudal furca; rudimentary second flagellum absent. Antenna 2: article 2, small dorsal spine present; article 3 with stout and fine setae; articles 3 and 4 not fused; article 4, with 3 rows of setae, 1 lateral row of stout setae with adjacent finely plumose setae and two rows of slender plumose setae; flagellum with many articles extending to caudal furca, heavily setose distally on each article.

Mandibular palp: article 2 with no medial setae; article 3,  $1.3 \times$  length of article 2, margins tapering slightly, 1 row of plumose setae along posterior and distal margin, long setae terminally; well developed molar process, without setal brush; mandibular incisor with 3 modified teeth. Maxilla 1: sympod, endite 1 narrowly rounded with a single row of 9 plumose setae, decreasing in length distally; endite 2 twice as wide as endite 1, slightly medially divided into two, each section with 1 row of short marginal spines; palp long, well developed, with 6 articles, 16 lateral setae and 2 terminal setae. Maxilla 2: with 4 endites; endite 1 margin with 8 plumose setae and 11 short spines; endite 2 rectangular with 7 short spines; endite 3, with 5 plumose setae; endite 4 fused with endite 5, with 5 plumose setae distally; endopod 2-articulate, tapering distally,  $1.1 \times$  length of exopod; mesial margin of endopod and lateral exopod with plumose setae.

Thoracopods: endopods foliaceous, epipods absent. Ratio of endopods T1:T3 and T1:T8  $1:1.36$  and  $1:1:0.6$  respectively. Ratio of exopods T1:T3 and T1:T8  $1:1.9$  and  $1:1.06$  respectively.

Thoracopod 1: endopod 6-articulate, with plumose setae along mesial margin; exopod  $0.8 \times$  length of endopod, lateral margin with plumose setae. Thoracopod 3: endopod 6-articulate, with plumose setae along mesial margin; exopod distally rounded,  $0.9 \times$  length of endopod, with evenly spaced plumose supra-cuticular marginal setae. Thoracopod 8: endopod incompletely 5-articulate (articles 1 and 2 not completely separate) with plumose setae along mesial margin; exopod tapering slightly,  $0.4 \times$  as long as endopod, with numerous plumose marginal setae.

Pleopods 1–4 posterior margin of peduncle denticulate; exopods 1-articulate; endopods 2-articulate, retinaculum attached to article 1, article 2 with long, fine plumose setae on lateral and mesial margins, 1 robust smooth seta and one short, stout spine terminally.

Pleopod 1: peduncle with single plumose setae; exopod,  $0.6 \times$  length of endopod, comb-row of short plumose setae along lateral margin of exopod absent, 14 longer plumose setae along lateral margin, 3 plumose setae terminally, mesial margin with numerous long, fine plumose setae. Pleopod 2: peduncle with anterior row of 7 plumose setae, single plumose seta distally; exopod,  $0.5 \times$  length of endopod, lateral margin with 9 smooth setae, 2 terminal setae, mesial margin with long, fine plumose setae. Pleopod 3: peduncle with anterior row of 5 plumose setae; exopod,  $0.5 \times$  length of endopod, 6 subcuticular plumose setae lateral, 3 smooth setae terminally, mesial margin with long, fine, plumose setae. Pleopod 4: peduncle with anteroproximal row of 4 plumose setae, 2 short plumose mesodistal setae; exopod,  $0.5 \times$  length of endopod, lateral margin with 9 simple setae, 2 terminally, mesial margin with long, fine plumose setae. Pleopod 5: uniramus, length  $3.1 \times$  width (not including peduncle); with 1 robust simple seta on terminal margin; fine plumose setae, on lateral and mesial margin. Pleopod 6: uniramus, length  $3.3 \times$  width (not including peduncle); with 5 robust simple setae on lateral and 2 on terminal margin; fine plumose setae on lateral and mesial margin.

Anal scales: triangular.

Caudal furca: length  $3.7 \times$  width;  $1.7 \times$  as long as telson,  $0.3 \times$  as long as carapace; with smooth setae on lateral margin and plumose setae on mesial margin, 1 terminal seta.



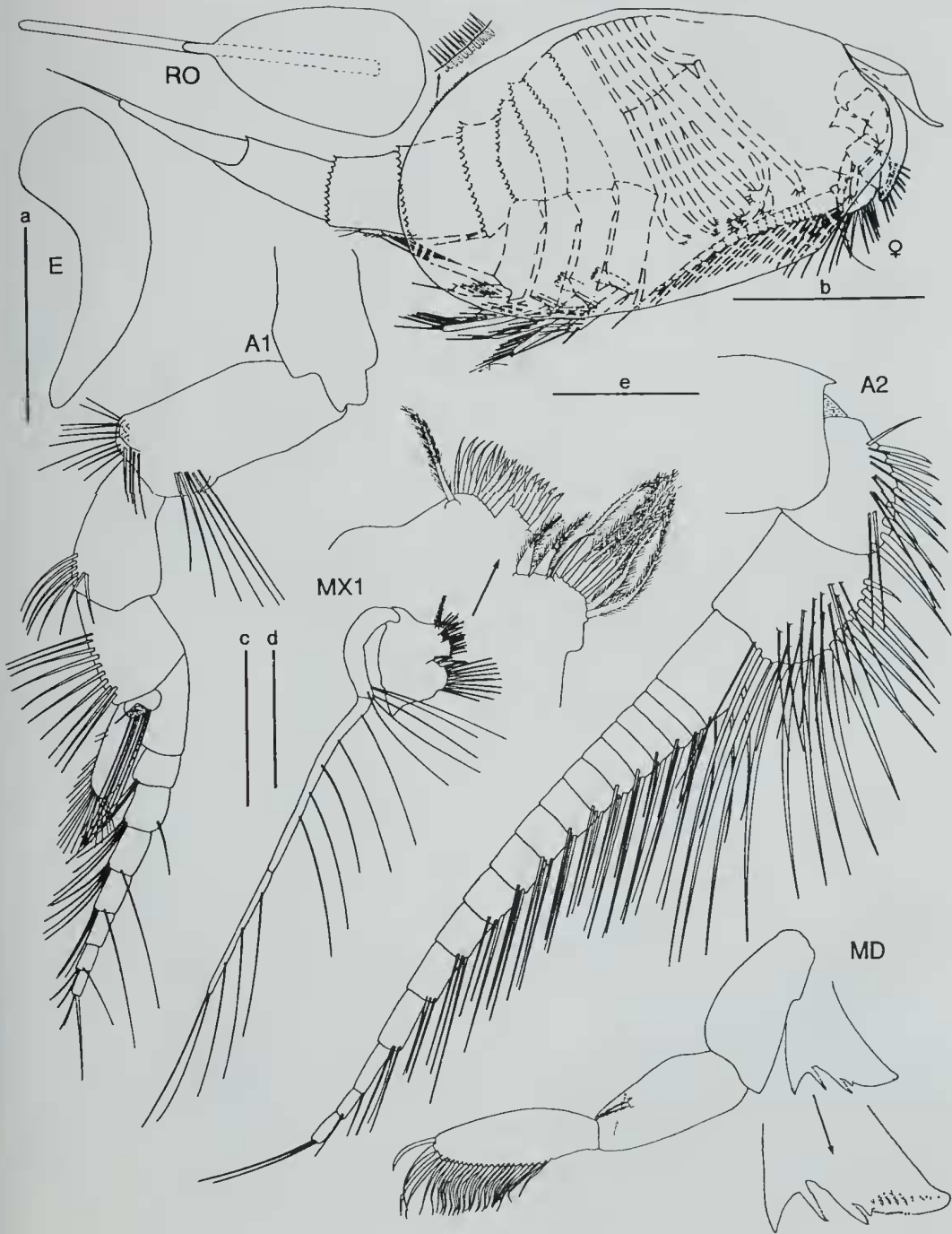


Figure 2. *Nebaliella declivatas*, female holotype. Dorsal view of rostrum. Lateral view of eyestalk. Mesial view of antenna 1 and antenna 2. Anterior view of maxilla 1, mandible. Scales a = E = 1 mm; b = whole body = 2 mm; c = A1, A2, MD = 1 mm; d = RO = 0.5 mm; e = MX1 = 1 mm.

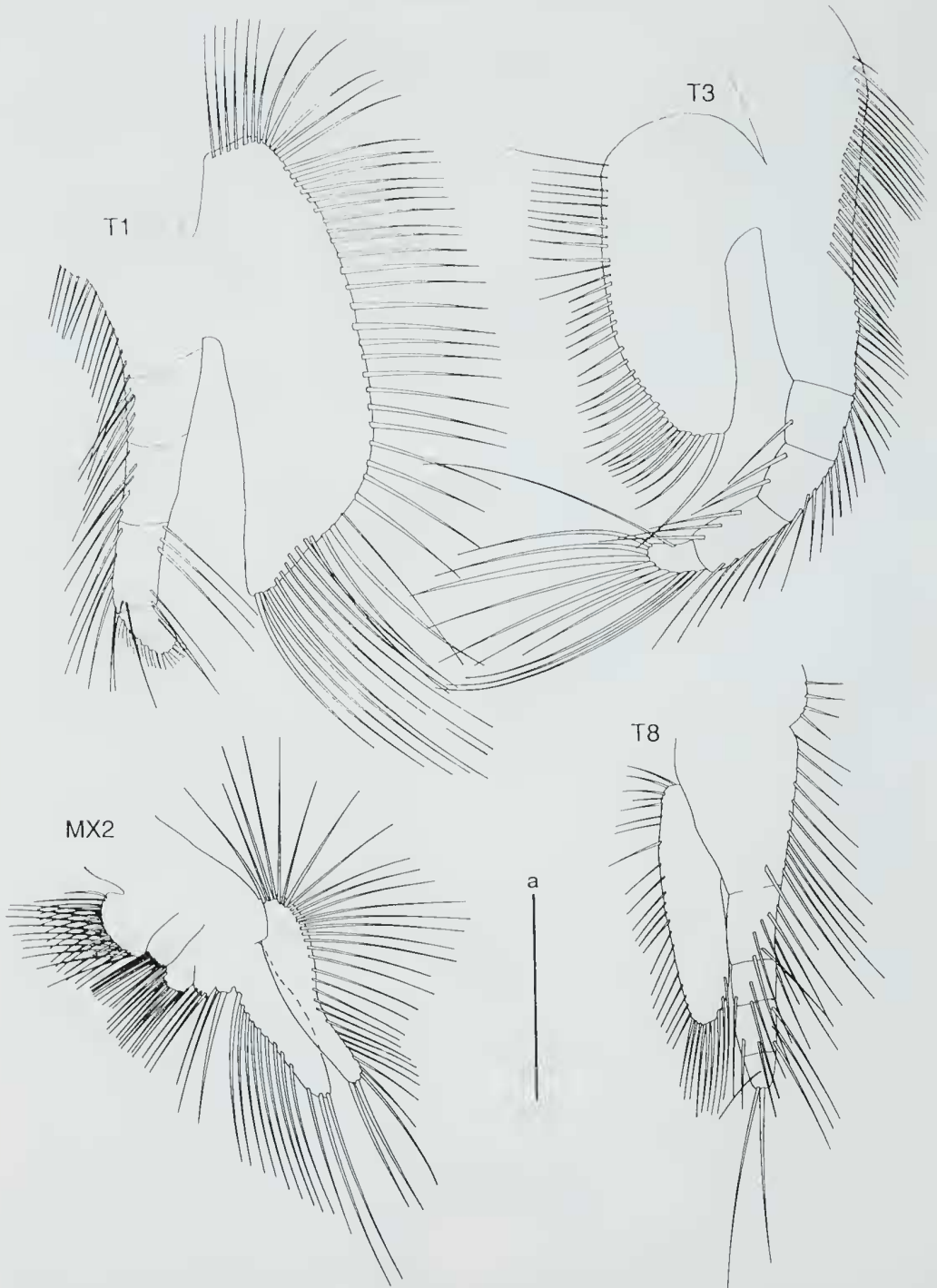


Figure 3. *Nebaliella declivatas*, female holotype. Anterior view of thoracopod 1, thoracopod 3, thoracopod 8 and maxilla 2. Scale a = 0.5 mm.

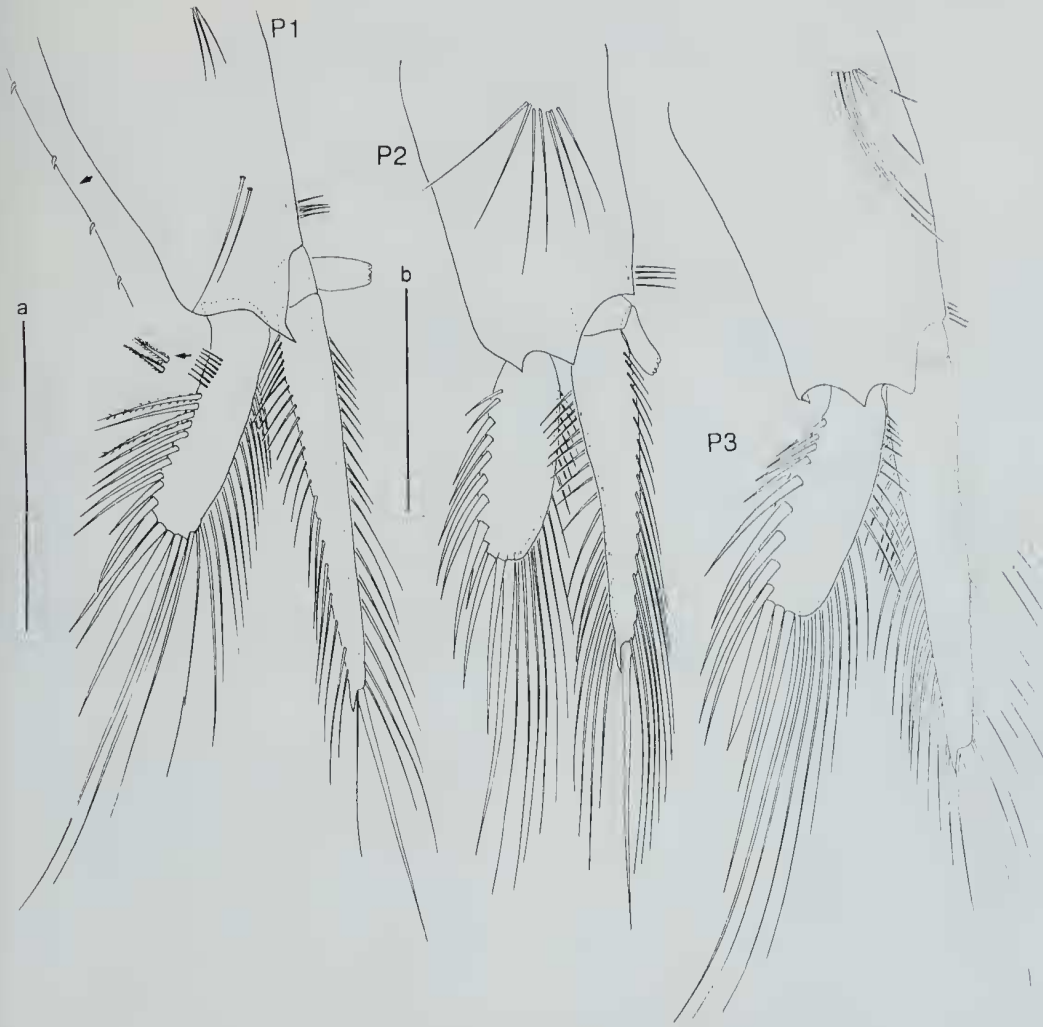


Figure 4. *Nebaliella declivatas*, female holotype. Anterior view of pleopods 1-3. Scales a = P1 and P3 = 1 mm; b = P2 = 1 mm.

**Etymology.** *Declivatas* (Latin) meaning a sloping place, referring to the continental slope where the holotype was found; noun in apposition.

**Distribution.** Point Hicks, Victoria, Australia; Nowra, NSW, Australia; Cape Tourville, Tasmania, Australia. 996-1840 m depth.

**Remarks.** The unique character separating *Nebaliella declivatas* from the other species of *Nebaliella* is the setation pattern of pleopod 1.

The overall appearance of the rostrum is similar to *N. extrema*, *N. caboti* and *N.*

*brevicarinata* with the ratio of the flange to exposed keel being 1:1. The rostrum of *N. declivatas* does not possess the ventral tuberculate process or heel found in *N. antarctica*, *N. extrema*, and *N. brevicarinata*. The carapace is relatively larger than for any other species, with the posterior margin extending beyond pleonite 6. Posterodorsally there is a row of minute spines on the ventral surface of the carapace, protruding just beyond the margin. This type of spination is also found on *N. antarctica*, *N. extrema* and *N. caboti*. These tiny spines may be present on other species but could have been

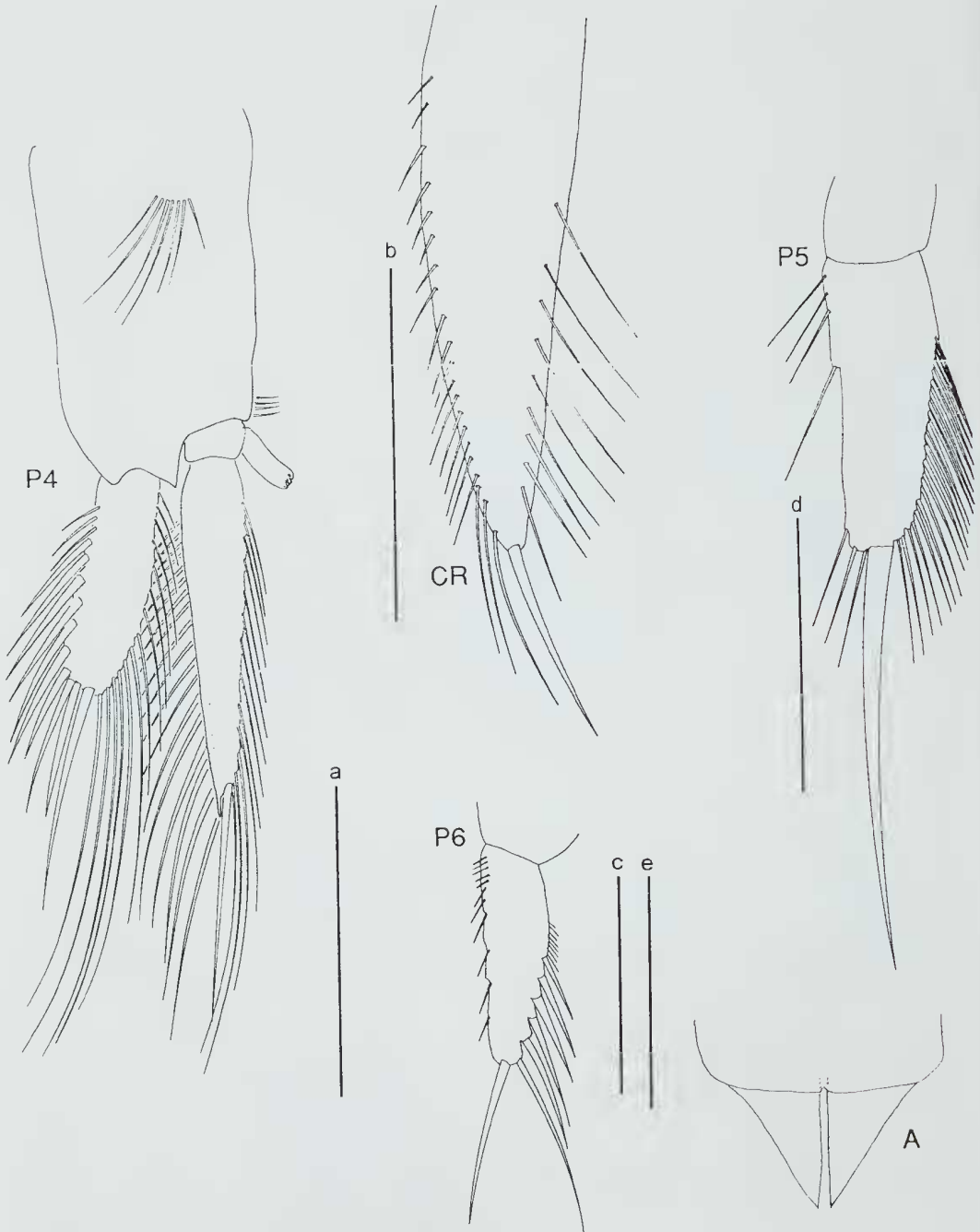


Figure 5. *Nebaliella declivatas*, female holotype. Anterior view of pleopod 4. Dorsal view of caudal rami, pleopod 5 and pleopod 6. Scales a = P4 = 1 mm; b = CR = 1 mm; c = P6 = 0.5 mm; d = P5 = 0.3 mm; e = A = 0.5 mm.



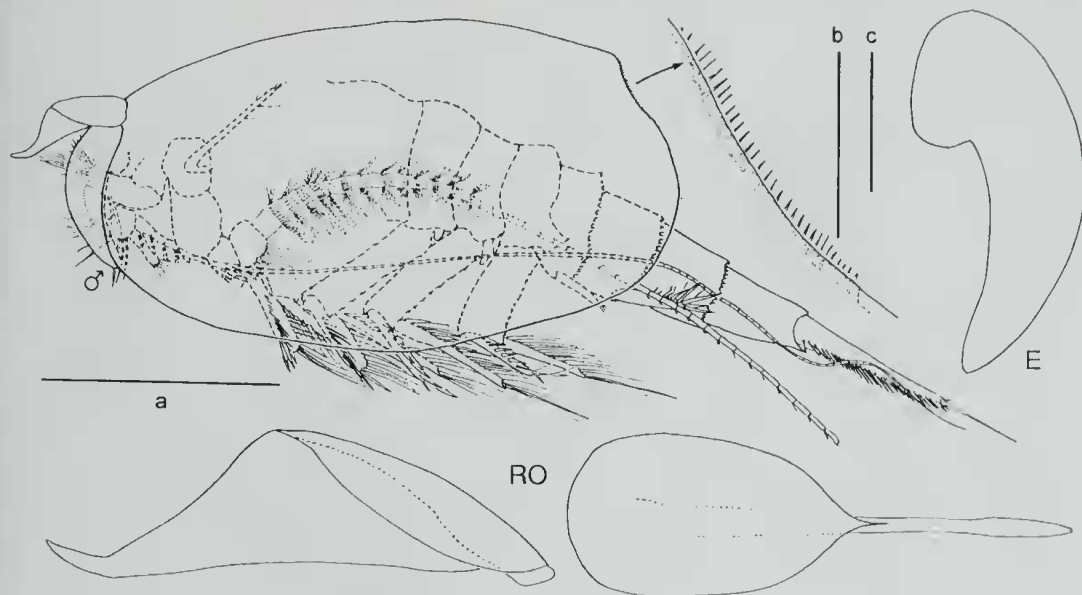


Figure 6. *Nebaliella declivatas*, male allotype. Dorsal and lateral view of rostrum. Lateral view of eye. Scales a = whole body = 2 mm; b = RO = 0.4 mm; c = E = 0.5 mm.

overlooked due to their small size. Antenna 2 does not possess a spinous projection on article 1 like that found in *N. brevicarinata* (Fig. 1G) nor is article 2 ornamented with the ventral horn-like projection or heel found on *N. antarctica* (Fig. 1C) and *N. extrema* or the slender seta as in *N. brevicarinata* (Fig. 1G).

The mouthparts of *N. declivatas* also differ from other species. The mandibular palp lacks the strong spine-like process found on article 2 in *N. brevicarinata* (Fig. 1H). The articles the protopod of the maxilla are fused, unlike *N. brevicarinata* which has 4 articles (Fig. 1I). Maxilla 2 endopod is 1-articulate in *N. declivatas*, as is the case for *N. caboti* and *N. antarctica*. The endopod of maxilla 2 is 2-articulate in *N. brevicarinata* and *N. extrema*. Thoracopod 8 is articulate in *N. declivatas*, *N. antarctica*, *N. extrema* and *N. caboti*. It is not articulate in *N. brevicarinata* (Fig. 1K).

One of the most striking characters of *N. declivatas* is the setation of pleopod 1. The female pleopod 1 exopod has a row of short plumose setae and 11 longer plumose setae along the lateral margin. This type of setal arrangement is similar to that found in *N. brevicarinata* which has 8 short spines and 9 longer setae but it is different from the exopod setation of *N. antarctica* (23 short setae and 8 long setae) and

*N. extrema* (17–19 short setae and 8–10 long setae) (Fig. 1M). The female pleopod 1 exopod of *N. caboti* is unknown.

#### Sexual dimorphism

The discovery of *Nebaliella declivatas* allows description of sexual dimorphism in several characters. The male antenna 1 peduncle article 1 is much broader than for the female and has a strong dorsal tooth. The mouthparts of the male are slightly modified. The male maxilla 1 endites are less setose than those of the female and endite 1 lacks the two stout plumose setae found in the female. The male endite 2 differs from the female having a single row of short robust setae instead of 2 overlapping rows of robust setae and a longer plumose seta. Proximally the protopod of the male palp is articulated but the female protopod is not. The maxilla 2 endopod is 1-articulate in the female and 2-articulate in the male. Thoracopod endopods are broader in the male, particularly thoracopod 3 and the thoracopod 3 exopod of the male is much larger than the female. The endopod of thoracopod 1 and thoracopod 3 of male has one more article than the female. The major variation in the pleopods of males and females occurs in the setation of pleopod 1. Males of *N. declivatas* lack the very small plumose setae found on the proximalateral margin of the exopod of the females.

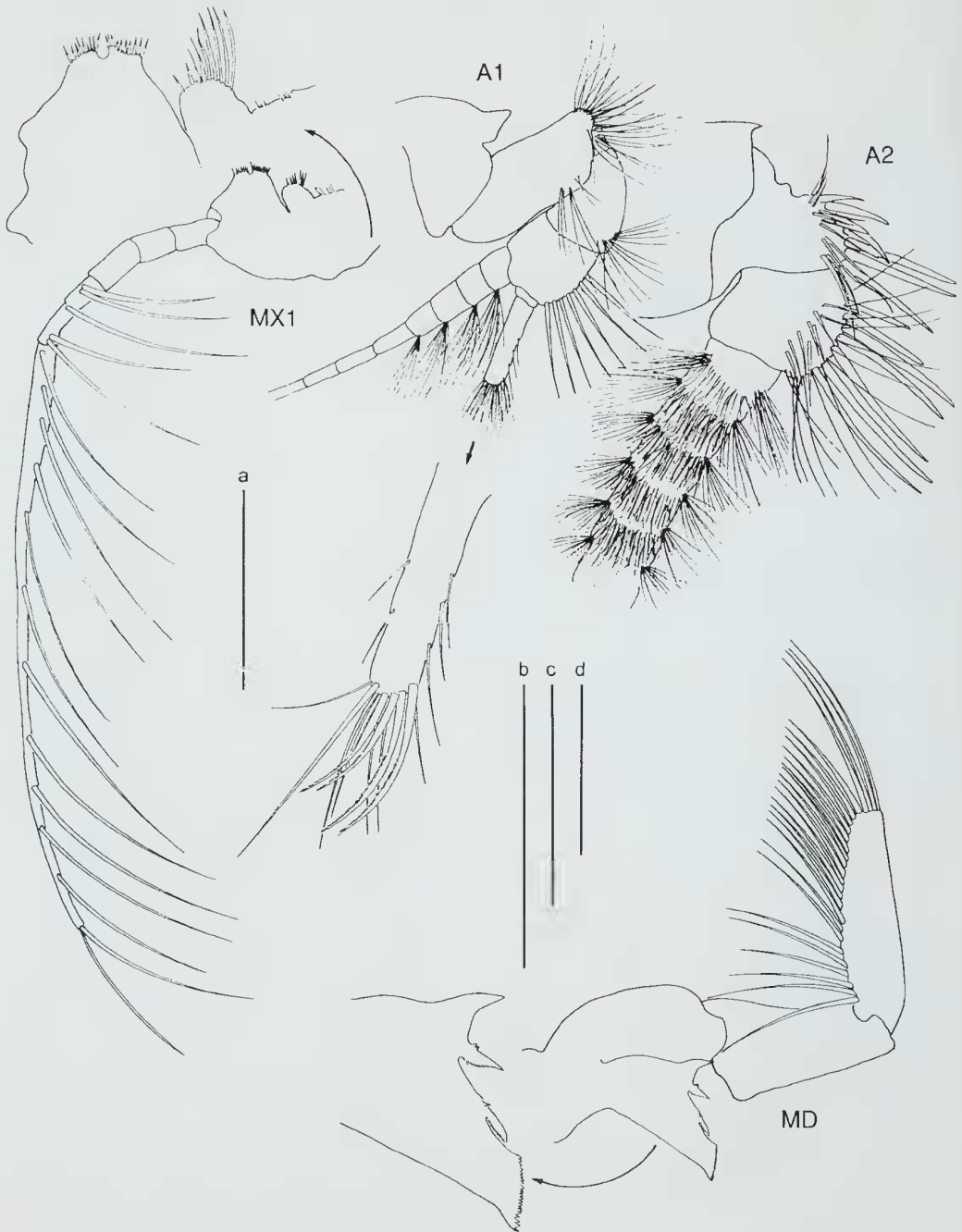


Figure 7. *Nebaliella declivatas*, male allotype. Mesial view of antenna 1, and antenna 2. Anterior view of mandible and maxilla 1. Scales a = MX1 = 0.5 mm; b = A1 = 1mm; MD = 0.5 mm; c = A1 scale = 0.3 mm; d = A2 = 0.5 mm.

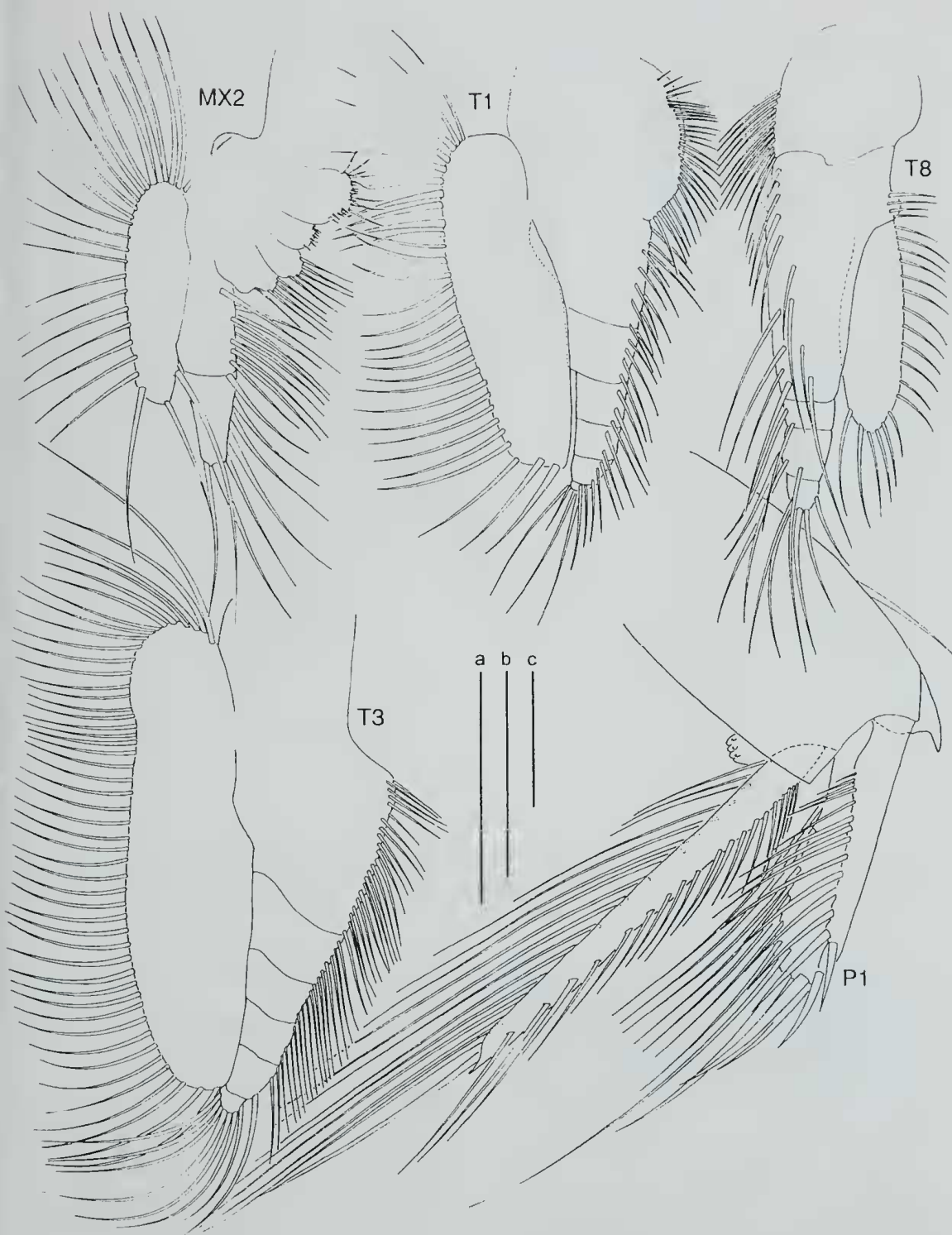


Figure 8. *Nebaliella declivatas*, male allotype. Anterior view of maxilla and thoracopod 1, thoracopod 3 and thoracopod 8. Lateral view of pleopod 1. Scales a = T1, T3, T8 = 0.5 mm; b = P1 = 0.5 mm; c = MX2 = 0.5 mm.

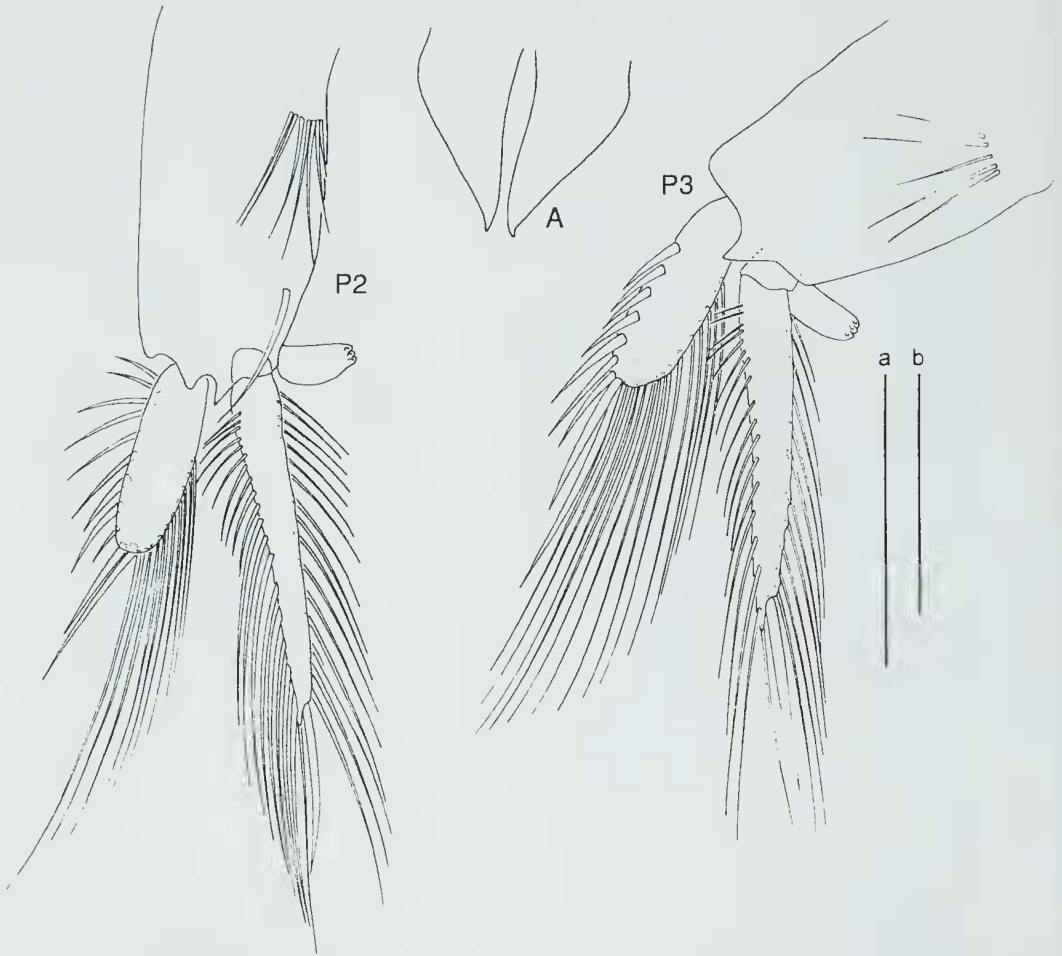


Figure 9. *Nebaliella declivatas*, male allotype. Anterior view of pleopod 2, pleopod 3 and anal scales. Scales a = P2, P3 = 1 mm: b = A = 0.3 mm.

The exopodal setation for the male pleopod 1 does not vary from the arrangement of setae found on pleopods 2, 3 and 4. The female pleopod 5 has a long smooth terminal seta but the male has a short stout one. The male caudal rami has a longer terminal seta and more heavily setose lateral and mesial margins than the female.

#### Acknowledgements

Special thanks to Dr Gary Poore for helpful comments and criticisms of draft manuscripts. This project is part of a wide-ranging exploration of the continental slope of southeastern Australia and has been supported by grants from the Australian Research Council and by the Victorian Institute of Marine Sciences.

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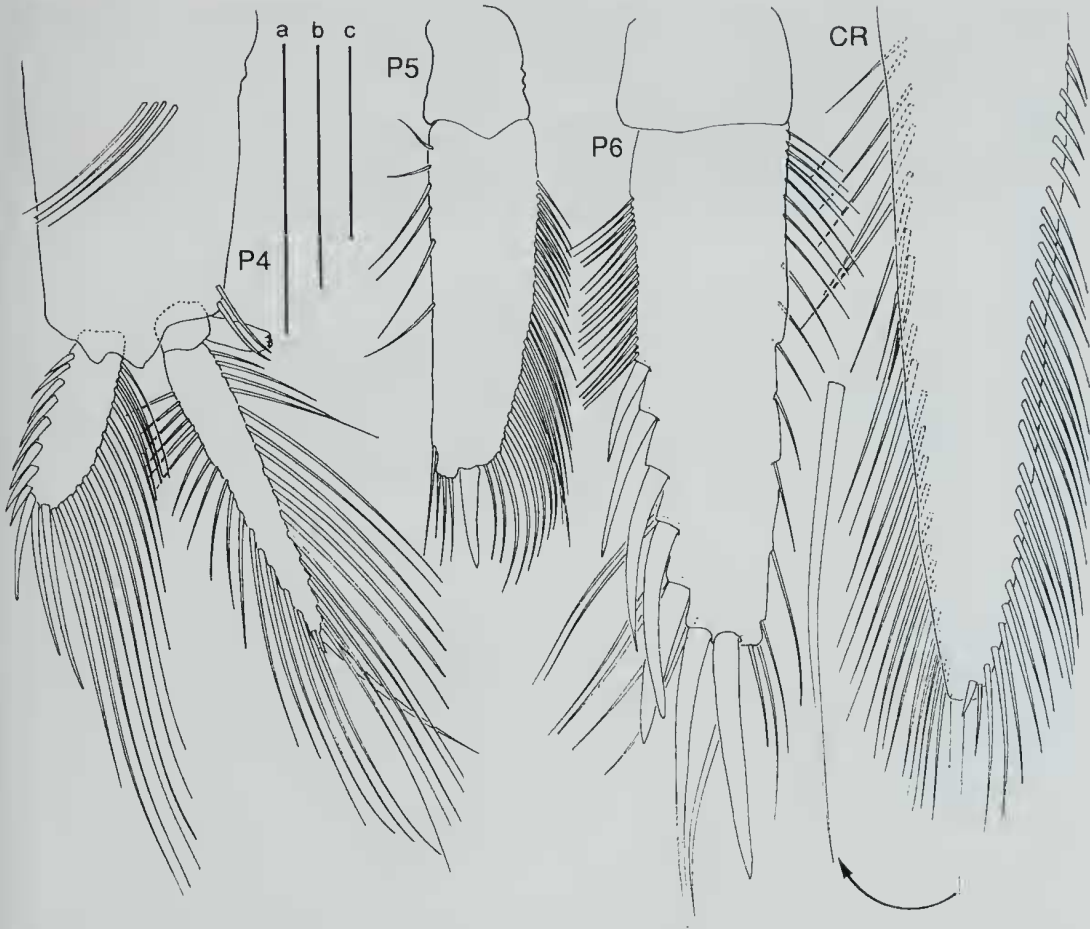


Figure 10. *Nebaliella declivatas*, male allotype. Anterior view pleopods 4-6 and caudal rami. Scales a = P4 = 1 mm; b = CR = 0.5 mm; c = P5, P6 = 0.2 mm

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